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# The role of community-based livestock management institutions in the adoption and scaling up of pigeon peas in Malawi

Leo Charles Zulu[a,*], Ellis Adjei Adams[b], Regis Chikowo[c], Sieglinde Snapp[d]

[a] Department of Geography, Environment and Spatial Sciences, Michigan State University, East Lansing, MI, USA
[b] Global Studies Institute, Department of Geosciences, Georgia State University, Atlanta, GA, USA
[c] Department of Soil Science and Agricultural Engineering, University of Zimbabwe, P.O. Box MP167, Mt. Pleasant, Harare, Zimbabwe
[d] Department of Plant, Soil and Microbial Sciences, Center for Global Change and Earth Observations, Michigan State University, East Lansing, MI, USA

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ABSTRACT

Although decades of research show long-duration pigeon peas (PPs) as a best-bet technology that enhances nutrition, soil fertility, crop diversification, food security, climate-change resilience, agroecological sustainability, and incomes of resource-poor smallholder farmers in Saharan Africa (SSA), PP adoption remains low. This exploratory qualitative study examines obstacles to PP adoption and their relative importance, strategies used to protect PPs from livestock damage, and the conditions that shape the emergence and effectiveness of Community Based Livestock Management (CBLM) arrangements to prevent PP damage. We conducted focus group discussions, participatory rural appraisal (PRA), and key-informant interviews in five communities at different levels and duration of PP adoption, and used theoretical insights from agrarian political economy. Livestock damage was the biggest obstacle to PP growing in new PP sites; poor markets and production factors dominated in the established sites. Individual crop-protection strategies were often time-consuming, costly, and/or ineffective. While chief-based livestock-management systems protected all crops satisfactorily during the rainy season, they were insufficient to protect PPs during the dry season. CBLM arrangements controlled livestock damage and protected PP relatively effectively throughout the year. Implemented only at the relatively established PP-growing sites, CBLM arrangements were most effective at the site (Mpokwa) where PP prices were good and markets reliable, PP was the top or major cash crop, PP growers were powerful and in the majority, and institutions pre-existed for use in CBLM. The findings lead to the following hypothesis: smallholder farmers are likely to invest time and energy in collective livestock-management approaches to prevent damage to pigeon peas when expected economic benefits of adoption exceed perceived costs for most growers, mediated by socioeconomic differentiation and power relations among major stakeholders. Future research should empirically examine determinants of CBLM emergence for PP protection and scale-up.

## 1. Introduction

Significant research shows that multipurpose and long-duration pigeon peas integrated into maize-based systems are a 'best-bet' technology for meeting multiple sustainable agricultural intensification needs of resource-poor farmers. Benefits include increased maize yields, improved nutrition and food security, incomes and livelihoods, soil fertility, crop and dietary diversification, cooking fuel production, and resilience to climate change (Kumwenda et al., 1997; Snapp et al., 2002, 2003a, 2003b; Gilbert, 2004; Bezner Kerr et al., 2007; Akinnifesi et al., 2011; Mhango et al., 2013; Jones et al., 2014; Pachico, 2014; African Center for Biodiverity, 2016; Smith et al., 2016; Zulu, 2016). Despite these multiple benefits, the availability of suitable sites in many medium to low rainfall areas, and growing international demand,[1] the adoption and productivity of pigeon peas (*Cajanus cajan*) remains low in Sub-Saharan Africa (SSA) although there have been recent gains (Snapp et al., 2002, 2003; Okalebo et al., 2006; Saxena, 2008; Akibode and Maredia, 2012; Pachico, 2014)[2].

The expansion of multi-purpose legumes in SSA requires concerted policies and strategies that address major barriers that smallholder

* Corresponding author.
*E-mail address:* zulu@msu.edu (L.C. Zulu).

[1] There was unmet global demand for PPs, especially in India (for processing into dhal), Malaysia, Singapore, the United Kingdom, and the USA (Akibode and Maredia, 2012; Makoka, 2009).

[2] PP production in SSA increased by 11% and 35% in yield and area planted, respectively, between 1994–1996 and 2006–2008 (Akibode and Maredia, 2012).

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farmers face. Common barriers include high labor demand, poor availability of and access to improved seed, low yields relative to other crops, late maturity of many varieties, pests and diseases, poor markets, and poor extension services (Bezner Kerr et al., 2007; Simtowe et al., 2010; Pircher et al., 2013; Mhango et al., 2013; Franke et al., 2014; African Center for Biodiverity, 2016). However, the literature shows that: (1) the relative importance of barriers is rarely studied, and (2) livestock damage (herbivory) is often neglected as a major barrier (exceptions include Snapp et al., 2002, 2018; Bezner Kerr, 2009; Me-Nsope and Larkins, 2016a). Pigeon peas (PP) are particularly vulnerable to livestock damage because they are a semi-perennial legume that takes up to eight months (60–235 days) to mature (Houérou, 2017). The long gestation enhances biomass production and provides additional longer-term agroecological benefits compared to regular benefits of most annual legumes – a nutritious edible grain, biological nitrogen fixation, and income generation.[3] Agroecological benefits include enhancements in soil organic matter and carbon, nutrient levels and diversity, moisture retention, and soil microbial activity (Kumar et al., 1987; Phiri et al., 1999; Rao et al., 2000; Snapp et al., 2002; Gilbert, 2004; Mhango et al., 2013). Yet because smallholder farmers in SSA generally intercrop PP within maize-based systems, the long gestation also leaves the PPs in the fields 1–4 months after maize and other annual intercrops have been harvested. This exposes PPs to heightened herbivory, which requires additional effort and resources to control.

Malawi epitomizes both the opportunities and challenges for scaling up PP production among poor smallholder farmers. The Government of Malawi's (GoM) agricultural and economic policies seek to double the contribution of legume and oilseed crops to agricultural production and to exports by 2020 in order to diversify the agricultural and export base away from maize and tobacco, respectively (GoM, 2012, , 2016). However, preliminary evidence suggests that livestock damage may be a significant barrier to PP adoption (Snapp et al., 2002; Bezner Kerr, 2009; Me-Nsope and Larkins, 2016b). Malawian farming communities have traditional systems to control livestock damage during the main growing season (November-April). While the systems also protect PP during its early stages of growth, the primary focus is protecting maize and associated annual crops. Yet why some communities develop community-based livestock management approaches (CBLM) that can reasonably contain livestock damage after maize harvests, and others do not, remains unknown and an important subject of research.

Using the cases of five sites in central and southern Malawi, and examination of socioeconomic and power differentiation using insights from agrarian political economy (Buttel, 2001; Bernstein, 2010), this study explores the emergence and role of CBLM for mitigating livestock damage to PPs within maize-based cropping systems. We use qualitative methods combining focus groups, participatory rural appraisal (PRA), and key informant interviews. The five sites were selected along a trajectory of, or duration since, PP adoption (low/none to high) in four districts of central and southern Malawi. The study specifically addresses the following questions:

1. What are the main obstacles to pigeon pea adoption and what is their relative importance?
2. What strategies do individual pigeon pea growers use to protect their crops from livestock damage, and how effective are they?
3. What factors facilitate the emergence and effectiveness of CBLM approaches for managing livestock damage to pigeon peas?

In the following sections, we briefly contextualize socioeconomic/class and power differentiation within an agrarian political economy approach to examine how it shapes cooperation and the emergence of CBLM to protect PPs. Following background information on Malawi and the study sites, we describe the methods used. Study findings cover barriers to pigeon pea adoption and their relative importance by site, level/duration of PP adoption, and strategies (individual, chief-based, and community-based) adopted to address livestock-based PP damage and their effectiveness. A discussion of salient issues, themes and ideas surrounding the emergence (or not) of CBLM and the role of socioeconomic/class and power differentiation, social structures, and institutions follows. We end with acknowledgement of study limitations before touching on potential implications and concluding the article.

## 2. Social, economic and power differentiation, and cooperative action

Insights from agrarian political economy can help to illuminate how differential relations of power in agrarian production may mediate the emergence of collective livestock management arrangements as smallholder famers respond to economic and other incentives and changing dynamics surrounding PP production. Agrarian political economy investigates "the social relations and dynamics of production and reproduction, property and power in agrarian formations and their processes of change, both historical and contemporary" (The Journal of Agrarian Change cited in Bernstein, 2010: 1). Engagement with critical agrarian theory is, however, beyond the scope of this study. We invoke elements of agrarian political economy narrowly as an organizing frame to examine how rural social and economic class and status may shape differential relations of power among key social actors and help to explain the emergence of CBLM to protect PPs.

The current study is more about enhanced understanding of what shapes the emergence of CBLM in the process of 'commodification of subsistence' as smallholder farmers mobilize their land and labor into PP commodity production than about Marxian/Leninist processes of class formation (Buttel, 2001). It is about "examining their differentiation"—particularly by socioeconomic classes—in order to know who benefits (Bernstein, 2010: 76). We frame the analysis of livestock-control/PP protection strategies around the four key questions of agrarian political economy that encapsulate social relations of agrarian production and reproduction; namely, who owns what, who does what, who gets what and what do they do with it (Bernstein, 2010)? The answers can reveal both the relative socioeconomic status of main actors, and their motivations, and their relative power within the social relations of PP and livestock production, which may influence the emergence and performance of CBLM. This approach goes beyond simplistic technology-transfer models (e.g., Rogers, 1962), and includes examination of the role of institutions in mediating the attendant power relations and accumulation of wealth.

Cooperation is an important strategy to enhance the productivity of farmers' labor. It produces "complementation effects" involving "adding individual labor to a process which only makes sense as a completed whole" (Bernstein, 2010: 17), e.g., investing individual effort in CBLM to protect PPs. It can produce economies of scale and beneficial timing effects, such as extending livestock control beyond the rainy season to protect PPs throughout the year. Just as the commons literature prescribes collective action through common-property systems as a solution to the common-pool resources problem (Ostrom, 2015), cooperation also makes sense in individual-level (petty) capitalist production. Bernstein posits that Marx's notion of the 'collective worker' extends to "people's capacity to organize themselves to make decisions about production, to carry them out and to innovate" (Bernstein, 2010: 29), as CBLM entails.

## 3. Study area and methods

### 3.1. Background and description of study area

Malawi is a small, densely populated, predominantly rural (84%), and agriculture-dependent country in southern Africa. Half (50.7%) of

[3] Over 37% of under-five children are growth stunted, 39% in rural areas (NSO, 2017b).

all Malawians lived below a USD 1/day poverty line in 2015 (GoM, 2017), and 82.7% of households engaged in agricultural activities (76.5% solely on rain-fed farming) during the 2015/16 growing season (NSO, 2017a, 2017b). The smallholder sub-sector constitutes most of the cultivated land and 70%-75% of agriculture GDP, but it is characterized by low inputs and outputs, small landholdings averaging 0.6 ha/household, declining soil fertility, and food insecurity (Asfaw et al., 2014; GoM, 2016).[4] Heavy dependence on rain-fed maize (*Zea mays* L.) as the staple food—76% of cultivated plots were planted to maize in Malawi between the 2014/15 and 2015/16 growing seasons (NSO, 2017a)—and on tobacco as the core cash crop (65% of export value, 2006–09 (GoM, 2011)) exposes Malawi's agriculture sector and economy to the vicissitudes of commodity-specific fortunes.[5] PP and other legumes offer the Government of Malawi (GoM) the opportunity to diversify the agricultural and export base while enhancing food security, nutrition and farmer incomes (GoM, 2012, 2016).

By 2016, Malawi was Africa's largest PP producer (followed by Tanzania) and the third largest globally (after India and Myanmar) (AICC, 2016), building on improving markets and increasing interest in PP growing for food and soil improvement, as well as cash (Mhango et al., 2013). Yet production quantities remain low, largely to southern Malawi although much of central and northern Malawi are also suitable biophysically (Benson et al., 2016; White and Crawford, 2016; Fig. 1). Further, 79% of the country's agricultural land has optimum climatic conditions for PP (Peter et al., 2017). As PP production creeps into central region districts of Kasungu, Lilongwe, Mchinji and Salima (AICC, 2016; African Center for Biodiversity, 2016), major barriers remain, and livestock damage may become more important, undermining efforts to scale up PP gro.

As in much of SSA, PP-producer prices in Malawi have increased faster than production. Prices increased 45% ($408/metric ton (MT) - $604/MT) 2000–2008 and peaked in 2016 at low/high levels of US $663/$1260 (AICC, 2016) while cultivated area increased by 26% from 160,000 ha 2006–08 (Akibode and Maredia, 2012) to 201,489 ha (8% of Malawi's arable land), yielding 237,098 MT in 2012 (GoM, 2016). Between 2008 and 2014/15, PP production increased by 201% to 335,091 MT (AICC, 2016). PP productivity has, however, remained low. Productivity increased from a quarter of full yield potential (2500kgs/ha) in the 1990s (Odeny, 2007; Akibode and Maredia, 2012) to a lowly third (800 kgs/ha) between 2008 and 2015 (AICC, 2016). Further, Malawi's participation in the international PP trade remains low and fragile.[6] The African Institute of Corporate Citizenship, AICC, estimates that Malawi exports only a quarter of its PP production, consumes 65% on-farm, and trades 10% locally (AICC, 2016). Recently, formal exports have fluctuated significantly, e.g., from 50,000 MT in 2011 to 20,395 MT in 2013, and 49,673 MT in 2015. Despite an increase in the number of processing companies and the presence of two commodity exchanges, markets remained largely informal, unstructured, and with spotty small, medium and larger-scale traders, but without a (government preferred) auction marketing system. An estimated US $60 million in export value lost to under-declarations (AICC, 2016) simultaneously reflects both the market underdevelopment and significant potential.

Malawi is among six African countries implementing the Africa Research in Sustainable Intensification for the Next Generation (Africa RISING or AR) program, a participatory action-research project promoting legume-based agricultural intensification. AR implementation in Malawi started in 2012. Our study contributes to the overarching research question shared by the AR project and the Global Center for Food Systems Innovation (GCFSI) Project that Michigan State University was implementing in Malawi. It is: "Where and how can multipurpose legumes be scaled for sustainable intensification of maize systems and what would the potential impacts be, in the medium term, across the food system in Malawi?"

Using information from AR project experts, local extension workers, prior knowledge, the literature and reconnaissance visits, we purposively selected five sites representing a trajectory in PP growing duration or levels (low/none to high) and duration to explore issues and themes surrounding the emergence of CBLM approaches to promote PP production. Each site covers an Extension Planning Area (EPA) *section,* the lowest agriculture-extension administrative unit covering 5–15 villages.[7] Three of the selected study sites were among (five) AR project sites — Linthipe (Dedza district), with no/minimal PP growing; Golomoti in Dedza and Kandeu in Ntcheu districts —new PP growing sites. We selected two sites with longer PP growing histories outside but close to the AR sites, namely Bazile EPA in Balaka district with an intermediate duration of PP growing, and Mpokwa EPA in Zomba district where PP growing dates back to colonial times (see Fig. 2). The premise was that the more established sites have had more time to develop effective strategies to livestock problems. The moderate rainfall (average 667–875 mm, maximum 1282 mm, falling November to March), temperatures and soil are suitable for PP growing (Benson et al., 2016; White and Crawford, 2016; Peter et al., 2017). Mean household-farm size ranged from 0.7 ha to 0.9 ha for the three AR sites. Local extension reports showed slightly lower average landholdings, 0.6 ha and 0.7 ha for Bazale EPA and Mpokwa EPA, respectively. This suggests that land endowment may currently not be a critical limiting factor in PP adoption or scale-up in the study area. Mpokwa farmers had the highest PP production among the sites, but they cultivated landholdings that were much lower than the national average of 1.5 ha and regional averages of 1.5, 1.9, and 1.2 ha for the northern, central, and southern regions, respectively (NSO, 2017b).

A 2013 baseline survey for the Africa RISING project suggests higher cattle and goat (main browsing livestock) ownership than the national average but similar across the AR sites: 51%, 54%, and 60% of households at Kandeu, Linthipe and Golomoti, respectively.[8] Goat ownership dominated cattle ownership by a 6:1 margin.

### 3.2. Methods

This exploratory study used mixed, qualitative social science methods to address the three research questions. Mixed methods help to contextualize and cross-validate findings for improved understanding (Creswell, 2014). In contrast to more top-down, theory driven qualitative analysis of food-policy issues (e.g., Thow et al., 2018), we use a more grounded, bottom-up analysis of the dynamics surrounding emergence of CBLM to control livestock damage in order to shed light on conditions that promote the adoption and scaling up of PP for food security, environmental and livelihood enhancement. We conducted Participatory Rural Appraisal (PRA), integrating Focus Group

[4] Asfaw et al. (2014, citing Chirwa and Quinion, 2012) estimate the smallholder share at 78% of cultivated land.

[5] National statistics referencing "over-dependence" on maize may overestimate the area coverage of maize because of widespread intercropping, and may underestimate the contribution of other crops to Malawian diets. For most farmers, growing as much maize as possible is a rational decision to avoid buying at higher prices later. During the 2015/16 growing season, the land plots dedicated mainly to maize growing averaged 0.8 ha nationally (NSO, 2017a).

[6] For instance, due to local overproduction, India capped PP imports from Malawi at 200,000 MT in August 2017 (60% of 2016 production). PP prices during 2016/17 plummeted, illustrating potential market volatility in Malawi.

[7] An Agricultural Extension Development Officer (AEDO) heads a section, supervised by an Agriculture Extension Development Coordinator (AEDC) who heads the EPA.

[8] The 2006/7 National Survey on Agriculture and Livestock shows that the project districts of Dedza and Ntcheu had slightly higher cattle and goat ownership (29% and 25% of households, respectively) than Balaka and Zomba districts, at 22% and 21%, respectively (NSO, 2010).

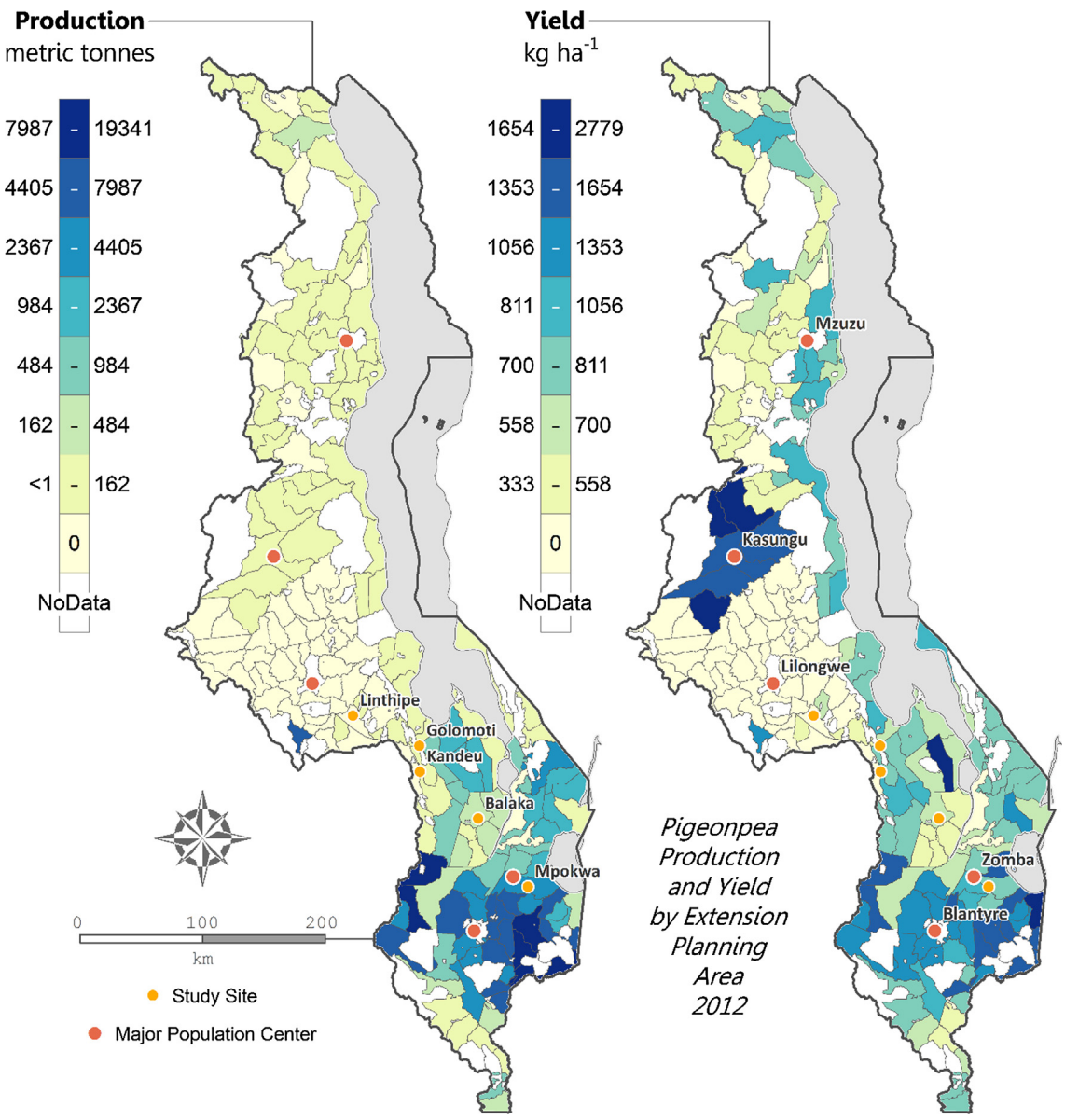


**Fig. 1.** Pigeon pea production by extension planning area, 2012. (Figure prepared by Brad Peter, Michigan State University.)

Discussions (FGDs) and other PRA tools, and semi-structured key-informant interviews (KIIs) of key stakeholders within and around the five communities. We also used investigator observations and secondary data review (government documents/reports, newspaper articles, AR project information, and published literature). The first two authors facilitated the FGDs, assisted by two seasoned local research assistants and a graduate student from the Swiss Federal Institute of Technology, Zurich, Switzerland. The authors obtained ethical research-review approval under the larger AR project at Michigan State University, and trained the assistants on interview instruments and the ethical conduct of research. The main data collection was done October - November 2014. We conducted an additional FGD and two KIIs in Mpokwa and Balaka, along with several follow-ups with local extension workers by phone and e-mail, mainly between October and December 2017.

### 3.2.1. *Participatory Rural Appraisal (PRA) and focus group discussions*

A PRA approach is suited to this qualitative study because, done properly, it fosters open discussion and interaction among participants, and consensus building on key issues surrounding PP adoption and barriers, including livestock-based damage and control. PRA tools help communities to systematically collect information, diagnose and prioritize their problems, identify solutions, and formulate intervention plans (Chambers, 1994, 1997). PRA tools used included FGDs, seasonal calendars to understand labor availability and bottlenecks, historical timelines of key village events/milestones, and participatory wealth analysis to understand the role of wealth class and power differentiation on livestock-control methods, including CBLM emergence

We conducted six FGD/PRA sessions involving 117 smallholder farmers from 17 villages, in the local language, Chichewa. They comprised one community FGD in each of the five study sites. Here 'community' refers to members from two to several villages located within an Extension Planning Area *section*. We conducted the sixth FGD with the Mathombo Village Agricultural Committee (VAC) in Mpokwa in order to understand the role, workings, and performance of a VAC in CBLM and PP growing. We selected participants purposively with the help of local extension officers while seeking to capture the widest local diversity. Participants included men, women, the youth, PP growers, livestock owners, other farmers, members of farmer clubs and other local organizations, and traditional leaders. Each session lasted

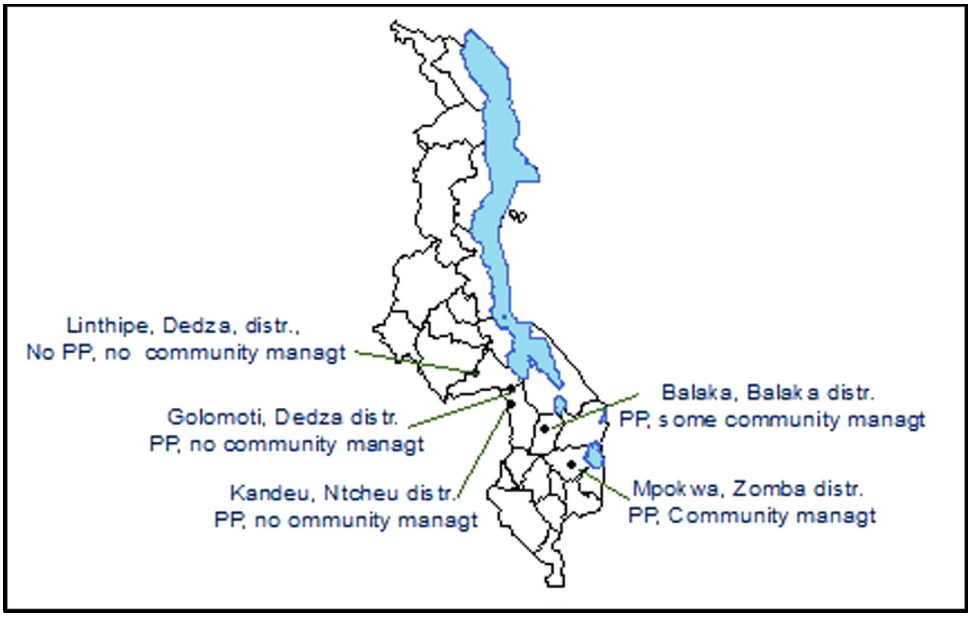


**Fig. 2.** Location of study sites.

2.5–3.0 h. Groups had 12–19 people, but one had 40. The facilitators took extra care to ensure active participation by all, including women, and to avoid domination of discussions by some individuals or groups, and we excluded local extension workers to allow the participants to speak freely.

Issues discussed in FGDs included village background, local livelihoods, and main crops grown and their relative importance. Participants also discussed PP-adoption levels, management practices, inputs (labor, seed, pesticides, and fertilizers), source and quality of PP-management knowledge, markets and prices, and perceived costs and benefits. Participants also identified barriers and rated their relative importance using the pairwise ranking technique (Fielding and Riley, 1998). They further discussed local strategies to limit livestock damage to PPs, institutional arrangements, and their effectiveness. Facilitators probed the emergence/origins, or not, of CBLM as a major livestock management and PP damage-control strategy. We used participatory wealth analysis to uncover local socioeconomic/class differentiation, and the relative power and placement of livestock owners and PP growers into wealth categories, to shed light on livestock control and emergence and performance of CBLM to protect PP.

#### 3.2.2. Key information interviews (KYIs) and secondary data review

In order to understand barriers to PP growing, choice of corrective strategies, and factors influencing CBLM emergence and effectiveness, we conducted 24 interviews with key informants selected from all the sites through snowball sampling. Being complementary to the FGDs, the small KII sample (3 or more per site) was sufficient to corroborate or fill thematic information gaps surrounding the social relations of PP production for the purposes of this exploratory study. Informants consisted of six local extension officers, eight PP farmers, six livestock farmers, and five village heads.[9] Interviews lasted 60–90 min. We also used descriptive contextualization by triangulating information collected from these and the multiple other data sources to explain emerging themes and issues around PP production and livestock control.

[9] One livestock farmer was included in the FGD for Mathombo Village Agricultural Committee at Mpokwa, conducted in October 2017.

### 3.3. Data analysis

We audio-recorded all FGD and key-informant interviews with prior consent from participants, transcribed them verbatim, and analyzed the data qualitatively. Using a process of open and axial coding (Priest et al., 2002), we derived emerging themes, their inter-connections, and related them to information from the FGDs and key informants. We focused on contextual, situational, and structural issues and themes, and relations of power surrounding PP production and emergence (or not) of CBLM. We use quotes from the FGDs and key-informant interviews to illustrate emerging themes or issues. We assessed the perceived relative importance of crops grown and barriers to PP adoption during the PRA/FGD sessions using the pairwise matrix or preference-ranking tool (Fielding and Riley, 1998).

## 4. Results

### 4.1. Main crops, their relative importance, and farmer motivations for growing them

Farmers grew similar crops across all the sites, but their relative importance and purpose varied. Common rainy-season crops included maize, legumes (groundnuts, beans, soya, pigeon peas, cowpeas, and bambara beans), tobacco, cotton, sweet potatoes, cassava, and pumpkins. Rice, sorghum, millet, sunflower, and paprika were less common crops. Dry season crops were mostly maize and vegetables, e.g., Irish potatoes, tomatoes, cabbage, carrots, cowpeas, green beans, onions, okra, cucumber, and eggplant.

For PPs, the relative importance of food, income, and soil-fertility enhancement as motivations for adoption varied by community. At the new sites (Kandeu and Golomoti) and the non-growing site (Linthipe), soil-fertility enhancement and food dominated income generation as motivations for growing PPs. Participants at the more established growing sites, however, ranked income among the top motivations for PP growing.

Pigeon peas were more important as a cash crop in the more established (Mpokwa and Bazale) sites than at the rest of the sites, where the crop was not among the top three cash crops (Table 1). This was partly a function of the relative novelty of PP. Maize, groundnuts, cowpeas, cotton and soya were variously among the top three cash crops at these new sites. Excluding maize, PP ranked the top cash crop

**Table 1**
Relative importance of the top three barriers and of pigeon peas as a crop.

| Community (PP adoption stage) | Biggest obstacle | Second biggest obstacle | Third biggest obstacle | Most important cash crop in decreasing order of importance |
|---|---|---|---|---|
| Linthipe (No PP) | Lack of farm inputs | Lack of markets | Pests and diseases | Maize, groundnut, cowpea |
| Golomoti (Transitional) | Livestock damage | Lack of farm inputs | Low market prices | Maize, soya, groundnut |
| Kandeu (Transitional) | Livestock damage | Late maturing of PP varieties | Poor yields | Maize, groundnut, cotton |
| Mpokwa (Established) | Low yielding PP varieties | Poor rainfall | Pests | Maize, pigeon peas, sweet potatoes |
| Balaka (Relatively Established) | Poor rainfall | Pests | Lack of markets | Cotton, tobacco, pigeon peas |

at the most established site, Mpokwa (beating sweet potatoes and tobacco) and third (after cotton and tobacco) at the relatively established Balaka site, Bazale.[10] Crop-surveillance records at Mpokwa showed that 70% of households grew PPs. This large proportion of PP growers was attributed mainly to relatively good markets, including the growing number of small agro-dealers and vendors buying PP from farmers, and growing demand in local and regional markets, e.g., Jali market in Zomba district and the Auction Holdings Ltd in Limbe, Blantyre city:

> From 2005, many companies were interested in pigeon pea products. That is why in those years, 2005 and 2007, there was a good market for the pigeon peas. In addition, that [raised] interest [of] farmers to start growing pigeon peas. From those years up to this year 2014, there is a tremendous increase in the growing of pigeon peas because the market seems to be very reliable (AEDO, Mpokwa key informant 2).

### 4.2. Pigeon-pea markets, reported prices and local perceptions

Reported PP prices and farmer satisfaction were highest for the Mpokwa community and lowest for the new growing communities, with Bazale/Balaka in between (Table 2). At Mpokwa, reported PP prices in 2014 were around 180 Malawi Kwacha (MK)/kg at local markets, and as high as 250MK/kg, 5.6 times the reported 2005 prices of around MK45/kg, in direct sales to agro-dealers and major food-processing companies in Limbe. The improved prices provided incentives for increased PP growing. Mpokwa farmers even established a PP cooperative in 2012, the Mpokwa Nandolo Cooperative,[11] to enhance their benefits from PP sales.

The use of the cooperative at Mpokwa to sell PP collectively and in bulk directly to the major agro-dealer, Auction Holdings Ltd in Limbe, Blantyre during the 2012/13 and 2014/15 seasons did not produce expected benefits. The cooperative was expected to enhance the negotiating power of smallholder farmers, and therefore PP prices, by bypassing vendors, small-scale agro dealers, and local markets (e.g., Jali) that offered low prices, unreliable buying schedules, and often used deceitful/exploitative buying practices. However, transportation costs and storage charges accrued for warehousing that the cooperative used in Zomba and Limbe while awaiting better prices eventually reduced gross profits and caused losses. After two seasons of poor performance, many farmers had despaired of trading through the cooperative. By 2016/17, the cooperative had scaled back, buying lower PP volumes from farmers and selling them only locally.

Membership of the Mpokwa Nandolo Cooperative comprised PP farmers drawn from 15 PP clubs across Mpokwa EPA. Its constitution provides for a 10-member executive elected from among the chairpersons of the PP clubs. The cooperative had separate sub-committees for production, marketing, discipline and other functions. It was supposed to be financially self-sustaining. Each member paid an entry fee of MK500 and had to buy shares every month valued at MK1000 per share.[12] Three quarters of the share revenues were to be distributed to shareholders annually, and 25% remained with the cooperative as operational funds. The leaders worked on a volunteer basis for now, but the constitution provides for pay. The Ministry of Irrigation and Water Development funded establishment of the cooperative to promote the trading of legumes, and the Ministry of Industry and Trade provided training and technical support. While the institutional structure, intent, and functions of the cooperative held promise, market realities and poor decision making undermined their effectiveness.

Reported PP prices, available markets and farmer satisfaction in 2014 were highest for the most established site (Mpokwa) and lowest in the new sites. At Mpokwa, poor markets were not among the top three barriers to PP production. The Balaka community was generally less satisfied with PP prices and ranked poor markets among their top three barriers (Table 1). Although PP growing was relatively established, formal markets and the value chain had not developed sufficiently. Further, Balaka is located farther from the major PP markets in Blantyre than Mpokwa is,[13] and Balaka-site farmers had not formed cooperatives to improve price-bargaining power. In the new PP sites of Kandeu and Golomoti, reported prices were lower (MK70/kg - MK190/kg). Complaints about poor markets and intermediary traders who offered farmers low prices were common, particularly in Kandeu (prices MK70-90/kg). Kandeu and Golomoti are located even farther from the Blantyre market (Fig. 2).

### 4.3. Barriers to adoption and scaling up of pigeon peas

#### 4.3.1. Barriers and their relative importance

Pairwise ranking revealed variations in the relative importance of main barriers to PP growing across sites and duration of PP adoption (Table 1). Communities at the new sites (Golomoti and Kandeu) ranked livestock herbivory the biggest barrier. Production factors such as lack of farm inputs (improved seed, early maturing PP varieties and pesticides), poor yields, pests and diseases, and poor markets and prices, were less important. In contrast, production factors dominated perceived barriers in more established growing sites. For Balaka (relatively drier), poor rainfall was the biggest obstacle, followed by pests and poor markets, while at Mpokwa, low-yielding varieties, poor rainfall and pests were the top barriers, in descending order. Most FGD participants and key informants at Mpokwa indicated that they had largely contained the challenge of livestock damage through CBLM. The situation was similar for Balaka, though some struggles remained with their rather passive form of CBLM. High labor demand, insufficient information on PP management, unreliable rainfall, buyers shifting demand based on varieties, poor grain taste, and high cooking-energy

[10] The FGD (VAC, Mpokwa) and KIIs (Mpokwa and Bazale) conducted in October 2017 showed the persistence of PP as the top cash crop, followed by maize, then groundnuts at Mpokwa. For Bazale, PP had become the top cash crop (followed by cowpeas and then tobacco)—cotton markets had collapsed (from 6500 to 400 growers) and tobacco declined—despite the near collapse of PP prices to K30/kg - K120/kg during the 2016/17 season. PP prices had reached highs of K600-K800/kg and MK500-MK600 at Mpokwa and Bazale/Balaka, respectively, during 2014/15.

[11] Nandolo is the local Chichewa name for pigeon pea.

[12] On November 30, 2014, USD 1.0 equaled MK 494.87. By October 15, 2017, it equaled MK723.14.

[13] Mpokwa farmers trace the growing of improved PP seed back to 2000/01.

**Table 2**
Reported pigeon pea prices for 2014.

| Site | Price, Formal Traders (MK/kg) | Price, Vendors (MK/kg) | Comments |
|---|---|---|---|
| Mpokwa | 250 | 180 | • Prices had increased significantly from MK45 in 2005 to MK120/kg at the beginning of 2014<br>• Cooperatives were formed in 2014 helped to bipass middlemen, boosted price to MK250 from corporate buyer<br>• Despite room for improvement, many were satisfied with prices (some indicated preferred prive of MK250/kg – the national grain board (ADMARC) sold PP at MK245-245/kg)<br>• There are several, reliable markets (Jali, Namikango, Nachuma) for local vendors<br>• Relatively close to Blantyre City for bulk sales to corporate buyers |
| Balaka | | 60–200 | • Increased in price from MK40-50/kg to MK40-MK100 in 2013<br>• No cooperatives or agreement on common prices<br>• Underpricing by middlemen is still a problem – can seel seed and MK60/kg and buy back at MK280/kg for seed |
| Golomoti | 180–190 | 150 or less | • The Agriculture Trading Company offered better prices<br>• Price in 2013 was MK150/kg<br>• Mostly unhappy with price; MK200/kg would be better |
| Kandeu | – | 70–90 | • Increased from MK80/kg and MK50/kg in 2013 and 2012, respectively<br>• Markets are poor and unreliable, and growers depended on vendors, middlemen, and other residents; reliable markets are far |
| Linthipe | – | – | • Lack of markets for pigeon peas<br>• Low prices in regular local markets |

1 United States Dollar was approximately equivalent to 402 Malawi Kwacha, MK in mid October 2014.

requirements were additional barriers across sites. While some complained about low yields with some early maturing PP varieties, none complained about poor soils. FGD participants and key informants at Linthipe (no/minimal PP growing) also perceived production inputs, poor market factors, and pests and diseases as the three major barriers to starting PP growing, in descending order. With minimal adoption, participants/respondents saw livestock damage as a distant barrier, along with long cooking times, and the novelty of PP in local diets.

#### 4.3.2. The nature and extent of livestock damage

Livestock damage to pigeon peas varied seasonally. It was highest in April and May when PPs are flowering and producing pods. During this time, maize and other annual crops have been harvested, and grazing restrictions imposed by village heads during the rainy season to protect annual crops have been lifted. As a result—but this is not the case everywhere in Malawi—goats mostly graze freely, although herders continue to tend (non-dairy) cattle and can lead them into agricultural fields to graze. Livestock damage to PP crops involved eating of leaves, flowers, and green pods, and at times damage to the entire crop. Browsing is more deleterious during or after the flowering stage when it undermines pod production. The PP crop can sometimes recover if attacked before flowering.

The extent of livestock damage varied by site. Damage was most severe in the new sites and lowest in the most established growing site, Mpokwa. Kandeu participants reported the most severe problem. Participating growers reported frequent and intense livestock damage that sometimes left farmers with nothing to harvest for food or sale. Many affected growers were demotivated from growing PP, as key informants from Kandeu and Golomoti illustrate:

> I have experienced it twice in the last growing season; both times the goats ate the leaves of the pigeon peas. [It has happened] Five times, at least, since I started growing pigeon peas. (Key informant interview 5, Kandeu)

> For pigeon peas, we liked it. The drawback is that we usually don't eat it because of the goats. They eat the pigeon pea before it has matured. However, for soya, we harvest something. We harvest [soya] earlier [shorter duration]. (Key informant interview 12, Golomoti)

### 4.4. Strategies to protect pigeon peas from livestock damage

#### 4.4.1. Crop protection at household level

Pigeon pea growers reported four household-level strategies to protect PPs from livestock damage: guarding, fencing, changing growing location, and applying repellents. However, cost, time/labor demands, and ineffectiveness limited application. Most respondents considered in-person guarding of fields too labor and time intensive relative to expected returns. Fencing was not cost-effective, especially because most PPs growers intercropped it with maize. Growing PPs near homesteads facilitated guarding. Growing PP far from villages and beyond the grazing range of most livestock reduced damage but required ownership or access to suitable land – a limited resource except for the better off. Long distances also increased travel time, exertion, and transport costs for the harvest while reducing monitoring and care, and increasing the risk of crop theft. Desperate for cost-effective solutions, some growers in new PP areas turned to unusual strategies. Two female farmers had applied goat faeces mixed with water to repel goats. Benefits were fleeting but labor intensive, requiring frequent applications of scarce goat faeces:

> I have tried many different techniques to deal with the goat problem. I tried mixing goat dung with water and splashing it on pigeon pea leaves. The dung was very smelly. The goats stayed away for only a period of two weeks. When the smell of goat dung wore off, the goats resumed attacking the crops. (Key Informant Interview 10, Golomoti)

#### 4.4.2. Livestock management strategies

Three livestock-management strategies for preventing PP damage emerged: household-based, chief-based, and CBLM approaches. They varied in the types of rules used (informal, formal), enforcement mechanisms, institutions, and seasonality (rainy versus dry season – see Table 3). Individual livestock owners always had the primary responsibility for controlling their livestock to prevent crop damage. Most goat owners at all sites used tethering to limit their grazing range away from cultivated fields. Cattle (and occasionally goat) owners employed herders to manage livestock and keep herds away from crops. They also often shifted grazing areas to uncultivated local *dambos* (wetlands) during the growing season. Stall-feeding of livestock in pens was rare (mainly limited to dairy cattle), laborious, and undermined by ongoing feed shortages.

**Table 3**
Livestock management strategies and individual/communal arrangements for the control of livestock herbivory.

| Community | Description | Extent of livestock damage | Livestock Mgt system in place (Formal/informal rules) | | Predominant livestock herbivory control mechanism | | Enforcement arrangements |
|---|---|---|---|---|---|---|---|
| | | | Rainy season | Dry season | Individual | Communal | |
| Linthipe | Not an established pigeon pea growing area (Control population for Africa the Rising Program). | Severe | Tether livestock, *dambo grazing* | None: free range grazing | Fencing, guarding fields | None | Chiefs/ Traditional leaders Neighborhood boys |
| Golomoti | A recent pigeon pea growing area (Africa Rising Program participant) | Severe | Tether livestock, *dambo grazing* | None: free range grazing | Guarding fields, applying goat dung to repel goats | None | Chiefs/ Traditional leaders |
| Kandeu | A recent pigeon pea growing area. Africa (Rising Program participant) | Severe | Tether livestock, *dambo grazing* | Mixed: Some livestock tethering, free range grazing | Guarding fields Stall feeding/restricting livestock in stall, using fertilizer to poison goats (rare) | None | Chiefs/ Traditional leaders |
| Mpokwa | Established pigeon pea growing area | Minimal | Tether livestock, *dambo grazing* | Tether livestock, *dambo grazing* | Guarding fields | VACs Farmer cooperatives | Chiefs VACs Farmer cooperatives Pigeon pea club Lead livestock farmer |
| Balaka | Established pigeon pea growing area | Mild | Tether livestock, *dambo grazing* | Tether livestock, *dambo grazing* | None | Livestock clubs | Livestock clubs Chiefs |

**dambo: wetland areas.
VACs: Village Agricultural Committees.

A chief-based system imposed loose but village-wide institutional arrangements over the livestock-control efforts of individual owners at all the sites. At the beginning of the rainy season (November/December), village heads used their traditional authority to impose livestock-grazing restrictions for the village in order to protect the community's maize and other annual crops from livestock. Notably, the lifting of livestock-grazing restrictions after maize is harvested (around April-May) leaves less protection for the semi-perennial PP crop, which remains in the fields until harvesting generally between June and August. Livestock owners graze their livestock more freely during these dry season months than during the rainy season months when traditional livestock-control methods are operational. Thus, PP protection is largely left to individual growers and livestock owners, loosely mediated under the traditional adjudication system. This was the case for the two new growing sites (Golomoti and Kandeu). In contrast, the more established sites (Mpokwa and Balaka), had an additional, more formal, community-level institutional layer administered by elected local organizations under CBLM. The organizations monitored and enforced the livestock-control rules and provided community leadership in protecting PPs during both the rainy and the dry seasons (Table 3).

### 4.5. Institutional arrangements for livestock management

#### 4.5.1. Chief-based livestock management system

Findings showed near universal awareness of the simple rules under the chief-based livestock-control system, which had three undergirding principles: (1) livestock owners should control their livestock to prevent damage to crops; (2) victims of livestock-caused crop damage have recourse to justice mainly within the customary-law system, including compensation from livestock owners; and (3) offending livestock owners may be penalized for the breach. Traditional leaders are the custodians and enforcers of these rules. The primary goal is to protect maize for the community good under the local practical and moral imperative that "*maize is life.*"

Resolution of conflicts involving livestock-caused crop damage followed a graduated path. Starting with bilateral discussions between livestock and crop owners, victims took unresolved cases to the village head, who further referred unresolved cases to the Group Village Head (GVHs) or a senior chief called a Traditional Authority (TA) up the customary-authority hierarchy. Bilateral conflict settlement reduced transaction costs of adjudication for the victim while the livestock owner avoided a potential fine from chiefs. Complainants preferred this approach if they perceived the village head as being weak, biased or untrustworthy.

Village heads heard crop-damage cases brought to them. On ascertaining culpability, they often set compensation levels proportional to the degree of damage, but the form (cash or kind), levels, and damage-assessment method varied by village, crop type, and season. The village head determined compensation levels independently, based on the plaintiff's assessment (e.g., in Linthipe), or together with the plaintiff (e.g., in Kandeu). Damage assessment was variously based on the number of PP plants or planting stations damaged, estimated PP loss by weight, or the number of animals involved. Village heads also levied penalties—graduated or fixed, and cash-based or in kind (e.g., chickens)—to sanction any breaches. Penalties were often more stringent during the rainy season than during the dry season when PP remained in farmers' fields:

> During the rainy season, livestock are well managed, and they are always herded; thus, from November to March livestock are always looked after seriously. Because when livestock are found damaging the crops, they [owners] do have to pay dearly, very dearly. Nevertheless, after harvesting the major crops like maize, soya, groundnuts, these rules are not enforced. (Focus group participant, Kandeu).

Livestock-damage cases referred up to the GVH or the TA often involved non-cooperative or repeat offenders, or those dissatisfied with the rulings of village heads. Conflict resolution followed a similar process as at the village level. Rare cases not resolved here, or those involving obdurate offenders, or violence, were taken out of the traditional system into the judicial system via the police. However, many respondents complained that the police considered these cases as civil, customary issues, and often sent them back to traditional leaders. Another complication was cross-village arbitration. Cases involving a livestock owner and victim from different villages involved higher transaction costs in terms of time and effort, and often the involvement

of traditional leaders from both villages. Bilateral settlement remained the first line of conflict resolution, often involving forgiveness or mutually agreed compensation, even as avenues for referral remained open.

Although the traditional chief-based system worked reasonably well to protect PPs and annual crops *during the growing season*, it was on its own insufficient to control livestock damage during the dry season after livestock restrictions are lifted but PP remained in the fields. Further, during the rainy season the chief-based livestock control system was less proactive, sanction-driven, and ex-post in terms of dealing with damage. In addition, because most power lay in the hands of village heads, effectiveness of the chief-based system varied with the chief's level of interest in protecting PPs, sometimes shaped by his/her position relative to the power/influence of the livestock owners and PP producers. Such challenges of limited interest or weak traditional authority were particularly evident at the Golomoti and Kandeu new sites. Although most (17 of 22) key informants indicated that village heads enforced livestock–control rules, there was minimal or no active monitoring of compliance, mainly because chiefs lacked the capacity. Many respondents also decried perceived weaknesses or lack of seriousness among some traditional leaders in dealing with reported PP damage and in sanctioning offenders. Some attributed it to the gradual erosion of traditional authority. One farmer aptly summarized sentiments emerging from Kandeu and Golomoti on reasons for weak rule enforcement among chiefs:

i. *They do not value pigeon peas. None of them grow it; so it is hard for them to appreciate the need to protect the crop;*
ii. *The village heads sometimes are afraid of livestock owners and are unwilling to rule against them; and*
iii. *The village heads often are livestock owners.*

(Lead farmer, Golomoti)

Frustration with repeated livestock invasions with apparent impunity for the owners, and weak, ineffective chief-based systems drove some PP growers to extreme measures, such as the poisoning of invading livestock. One of two known farmers involved rationalized livestock poisoning, thus:

> ... Livestock can be controlled though poisoning by mixing urea [fertilizer] and maize bran to kill them and prevent them from further damaging the crops. This is no offence to the chief as everyone is now supposed to control and protect their livestock through their own means. I have experienced damages twice in the last growing season and I was denied payment for damages (Key informant interview 5, Kandeu).

Prevention was important given widespread complaints that compensation levels rarely sufficiently covered the damage, and were often paid late, if at all (e.g., Kandeu), due to poor enforcement or the inability of offending livestock owners to pay. Reported compensation in October 2014 ranged as low as MK 100 (approximately US $0.25) to MK 3000 (US $7.46) per goat (in many cases negligible since a small number of goats can damage an entire crop), and in a rare case in Bazale EPA, Balaka, MK80,000, according to the local extension worker, AEDEC. For the Balaka community studied, compensation was a lowly cash equivalent of 2.5–5.0 kg of PPs per goat. Repeat livestock invasions could debilitate growers even when agreed compensation was duly paid.

#### *4.5.2. Community-based livestock management system — actors, roles, and performance*

Most focus group participants and key informants expressed preference for CBLM to other strategies to prevent PP damage. CBLM had emerged at Mpokwa and was in earlier stages at Bazale/Balaka. Both these communities adopted pre-existing organizations to support CBLM – Mpokwa relied heavily on Village Agricultural Committee (VACs) while the Bazale/Balaka community leaned loosely on farmer clubs with heavier reliance on the chief-based system. An advancement on the chief-based system, the village and cross-village community organizations and institutional arrangements added under CBLM expanded the division of labor within the social relations of PP production by taking on a monitoring/enforcement role. The VAC helped to reconcile or channel (next section) the diverse interests and wealth-class based power relations among livestock owners, PP growers, traditional leaders, and their communities.

The Mpokwa community introduced CBLM through VACs in 2007. Being part of Malawi's decentralized, nested-scale agriculture extension system, the sustainability of VACs was relatively assured. Each VAC has 10 executive committee members – farmers with better-than-average agricultural knowledge/skills and ability to read and write. Half the members are elected on three-year, re-electable terms while traditional leaders nominated the rest. Gender balance is sought. Two executive VAC members serve on the Group Agricultural Committee (GAC) operating at the larger scale of a Group Village Headman, GVH (Table 3). The GAC chairperson serves on the Area Stakeholder Panel (ASP) that operates at the higher hierarchical level of the Traditional Authority (TA, senior chief) drawing on broader stakeholder participation. The ASP is represented on the multi-stakeholder District Stakeholder Panel (DSP), which addresses agricultural issues at district level, working with the District Assembly's District Agricultural Committee. This institutional nesting broadened community ownership of CBLM, and elevated PP growing and protection into broader agricultural and rural development agendas and decision-making at District level.

The VAC at Mpokwa, and to a lesser extent farmer/livestock clubs at Bazale/Balaka, played multiple positive roles on CBLM that enhanced the chief-based system. VAC members facilitated the formulation, monitoring and enforcement of agreed livestock-control rules, sensitized and educated community members on the value of both livestock and PP, and the need for CBLM efforts to promote mutual co-existence. The main livestock-control rule for the Mpokwa community required the restraining of livestock (in pens, on tethers, or by herding) *throughout the year*. The village head would levy a fixed fine to the livestock owner for breach of the rule based on verified damage to PP and other crops. The VAC also supported village heads on livestock control and sanctioning. VAC members taught local farmers best PP-growing practice and livestock management. The VAC was also the first line of conflict resolution in cases of livestock damage. VAC members mediated some bilateral negotiations and helped take unresolved ones to the village head. The VAC also acted as a secretariat for the village head, including writing upward referral letters for livestock-damage cases to the GHV, TA, or the GAC.

Regular VAC roles included identifying barriers to agricultural development, proposing and facilitating implementation of solutions. The VAC helped identify lead farmers to assist in dissemination of advanced agricultural knowledge/technologies, and linked farmers to local extension agents, NGOs and other stakeholders. A VAC had a constitution and legal mandate. Members met monthly and were subject to both downward and upward accountability within the agricultural extension system, including obligations for regular reporting to the village head, GVH, and the GAC.

In sum, the VAC enhanced the capacity of the village head to enforce livestock rules in a holistic manner, and beyond what the chief-based system could do. The embeddedness of the VAC in the web of relations with key actors in PP growing, livestock management, and agricultural development enhances the VAC's role. Most notable for Mpokwa was the role of Mathondo VAC in facilitating development of rules or bylaws. The VAC developed the idea of a fixed fine of MK5000 to be paid by the livestock owner as compensation to the affected PP grower regardless of level of damage, and as a deterrent. The VAC took the idea to the village head who endorsed it and brought it up to a village meeting for community discussion and adoption. The VAC further influenced the GAC to meet and adopt a stiffer fixed penalty of

MK10,000 for cases referred to the GHV. A similar meeting induced at ASP level adopted the steepest penalty of MK15,000 for livestock-damage cases referred to the TA. This unique graduated, multi-scalar sanctioning system combined with the year-round livestock restriction deterred livestock owners, and facilitated PP growing and scaling up. The fixed nature of the fine, and the fact that the full amount went to the plaintiff (none to the chief), enhanced the even-handed treatment of culprits and plaintiffs, and minimized the risk of corruption. Livestock owners in Mpokwa generally kept their goats within homesteads overnight to prevent theft, and increasingly restrained the goats in simple pens during the day, facilitating implementation and enforcement of the year-round livestock restrictions. As a VAC member noted, tethers can break and/or limit goat nutrition, while the pens address both problems.

The foregoing CBLM institutional arrangements help to explain the more effective livestock control and lower levels of livestock-based damage to PPs observed in the communities implementing some CBLM (Mpokwa and Bazale/Balaka) than those that did not, and why the Mpokwa community had the best livestock control as manifested in their local ranking of barriers to PP production (Table 3). A VAC member attributed Mpokwa's success to the community sensitization/education component. Even at the Bazale/Balaka site, where institutional arrangements were less elaborate, discussions revealed that the assistance of farmer clubs to the village head and community on livestock-control arrangements helped to reduce cases of PP-crop damage and conflict between growers and livestock owners. However, social differentiation and power relations appeared to influence CBLM emergence and functioning.

### 4.6. Selected contextual factors surrounding CBLM and crop–damage control

#### 4.6.1. Power relations

Social class differentiation and power relations among main stakeholders, particularly between livestock owners and PP growers, were a major theme on the choice or emergence and performance of livestock-control approaches. FGD participants characterized socioeconomic differentiation into wealthy, moderately wealthy, poor, and very poor classes (Table 4). Attributes of wealth classes were similar across sites. Those perceived to be the wealthiest generally had agricultural productive assets (sufficient land, labor, fertilizer, seed, pesticides) and used them as capital to enhance their reproduction (sufficient, varied, and good quality food all year; a good house; ability to pay school fees/costs; good clothes and personal hygiene; and owning a range of household items). Those considered moderately wealthy had slightly lower sufficiency on the stated production and social reproduction attributes. In contrast, the very poor farmers were caught in a vicious cycle of minimal productive assets, which prevented them from meeting their basic reproductive needs, further undermining asset building. Bernstein (1979) termed this *the simple reproductive squeeze.* The poorest generally lived in thatch/mud/pole houses; some sold or rented out all/parts of their farmland; could not afford fertilizer, school fees/costs, or basic household needs/assets; sold their labor for casual work (*ganyu*); had poor hygiene/health; and their self-grown food lasted no more than two months. The poor category was only slightly better off.

Variation in the relative placement of PP growers and livestock owners by wealth class was another notable theme. Mpokwa FGD participants placed livestock owners in the top wealth category and PP farmers in the moderate wealth class atop all crop producers. FGDs and KIIs revealed a confluence of interests and relative balance in power relations between livestock owners and PP growers regarding livestock control. With reasonable PP prices from 2013/14 to 2015/16, the closely ranked wealth status of livestock owners and PP growers allowed both groups reasonable access to the means of commodity PP production, family and hired labor, seed, and pesticides. Significantly, many livestock owners at Mpokwa also grew PP. The combined influence of PP growers and PP-cum-livestock farmers facilitated community acceptance of CBLM and the functioning of CBLM arrangements, including all-year livestock restrictions and fixed fines for offenders. The FGDs at Mpokwa revealed additional community benefits from CBLM, including protection of prepared fields from livestock-trampling damage, and the protection of property (food, drinking water, household items, etc.). A 'model' livestock-producing farmer from Mpokwa further credited the CBLM livestock controls with improved management of his livestock. They encouraged him to stall-feed the livestock while also protecting them from theft. A village head indicated that livestock confinement also prevented conflicts and occasional intentional poisoning by aggrieved parties.

Composition of the VAC emerged as another notable dimension of social differentiation that may influence CBLM emergence and performance. At Mpokwa, all the 10 members of Mathombo VAC were PP farmers, producing 0.5–9 bags of grain (in 50-kg sacs), averaging 3.6 bags for 2016/17. Three of the ten VAC members (and five of the 12 FGD participants) also owned browsing livestock. PP growers and interests dominated both within the VAC (over livestock owners) and within the community, and therefore had both the motivation and significant influence to help promote and enforce livestock control via CBLM. The village head was also a livestock owner and PP grower who both understood the stakes and had positive influence over introduction of CBLM for PP protection. The combined influence counteracted the potential power of livestock owners who had a slightly higher wealth class and non-producers of PP whose wealth status the PP growers outranked.

**Table 4**
Participatory wealth analysis results for Kandeu and Mpokwa sites.

| Metric | Kandeu | | | Mpokwa | | |
|---|---|---|---|---|---|---|
| | Poor | Average | Rich | Poor | Average | Rich |
| Food | Inadequate food | Occasional hunger | Enough food | Inadequate food | Adequate food | Surplus food |
| Income | No income | Irregular income | Regular income | Few income sources, No income source | Good source of income<br>Casual labor for income | Steady income |
| Livestock | No livestock | Some livestock | Owns goats and cattle | Owns no livestock | Has few livestock | Owns various livestock |
| Housing | Non-brick house<br>No iron sheets on house | Bricks or<br>House with iron sheets | Bricks and iron sheets on house | Roof is grass thatched or leaky | Small house | Owns big house with iron roofing |
| Clothing | Few clothes<br>Dirty clothes | Buys clothes occasionally | Buys clothes regularly | Tattered clothes<br>No shoes | Dirty clothes | Has many clothes<br>Clean clothes |
| Transportation | Walks/no transportation | Owns ox-cart | Owns car | Owns no bicycle | Owns a bicycle | Owns car(s) |
| Pigeon Pea farmers | ✓ | – | – | – | – | ✓ |
| Livestock farmers | – | – | ✓ | – | ✓ | – |

The new sites (Kandeu and Golomoti), and Linthipe, shared low or no importance of PP as a cash crop (Fig. 1, Table 1) and relatively low prices. The perceived power differential between livestock owners (wealthiest class) and PP growers (the poor class) was the highest for Kandeu, where it gave livestock owners considerable sway over PP growers and village heads on matters of livestock control and resolution of associated conflicts over PP damage. Kandeu had the worst livestock damage problem and barrier to PP production/adoption. Even for the Golomoti and Balaka sites, where the socioeconomic differential was smaller–wealthy versus moderately wealthy classes for livestock owners and PP growers, respectively—it failed to empower PP growers or attract sufficient interest among powerful livestock owners to promote PP production. Many participants complained that livestock owners often reduced PP growers' complaints about crop damage to jealousy. Yet a livestock owner who also grew PP in Kandeu narrated forgiving another livestock owner for crop damage because he empathized with the latter. CBLM arrangements had not emerged at Kandeu, Golomoti and Linthipe.

Further, without community institutions to support livestock control, PP growers depended on the chief-based system, with its seasonal enforcement and other limitations, and household-level strategies (Tables 1–3). The effectiveness of community sanctioning and deterrence depended mainly on the capacity and idiosyncratic qualities of village heads, e.g., personal interest and whether they commanded respect from community members, including powerful livestock owners, or not. Respondents and FGD participants in Golomoti and Kandeu, where livestock damage was the biggest obstacle to PP growing also shared concerns about weak or disinterested village heads who also feared or favored powerful livestock owners in the resolution of PP-damage cases (previous section).

#### 4.6.2. *Extension service delivery and other contextual factors*

Other issues may help to explain differences in livestock control for PP protection. They include the quality of extension services, duration of PP growing, and current or previous projects promoting PP growing. All the sites had some project/program promoting PP growing. For instance, the Africa RISING project has promoted PP growing in Linthipe, Golomoti and Kandeu via participatory action research (the mother-baby-trial) approach. The project provided free seed, training, and extension services to participating farmers. Mpokwa had also benefitted from National Association of Smallholder Farmers of Malawi's (NASFAM's) seed pass-on and multiplication program. Farmers indicated that they received 2 kg of certified PP seed and returned 5 kg after harvest. Conversations also revealed that Mpokwa residents benefitted from training on building and managing cooperatives from the Ministry of Industry and Trade, and support for PP production from the Competitiveness and Job Creation Support Project in the Ministry of Agriculture, Irrigation and Water Development. Close cooperation among local extension staff, non-government organizations, village heads, and farmers to promote PP growing were also most evident at Mpokwa. At Balaka, the local extension agent broadened livestock-club membership and roles beyond livestock recipients in a pass-on goat project, thereby helping to sustain the clubs which were later used for use in PP protection from livestock.

On duration of PP growing, FGDs and KIIs indicated that Mpokwa residents had the longest history dating back to colonial times when residents learnt PP growing through employment on European-settler farms. However, respondents indicated that they grew PP only for subsistence until recent market openings in 2012/13. This may help to explain the higher importance of PP not only as a crop, but also as a major cash crop. The PP growing experience may have allowed Mpokwa farmers to take advantage of emerging market opportunities faster than other communities.

## 5. Discussion: Themes and issues surrounding the emergence of CBLM

Initial findings from this exploratory, qualitative study lead us to generate a working hypothesis: smallholder farmers are likely to invest time and energy in collective livestock management approaches to prevent damage to pigeon peas when expected economic benefits of adoption exceed perceived costs for most growers. Socioeconomic differentiation and power relations among major stakeholders and institutions mediate the emergence of CBLM arrangements. CBLM emerged as a solution to PP damage in communities (Mpokwa and Balaka) with favorable economic incentives (reasonable PP prices, accessible reliable markets, PP being among or *the* top cash crop), relatively long duration of PP production, and cooperating community social actors (chiefs, the wealthy, PP growers, and livestock farmers).

The Mpokwa site had the most developed and effective CBLM institutional arrangements spearheaded by the VAC working in tandem with village heads. The better PP prices and market access also reflected Mpokwa's close proximity (approximately 75 km) to Malawi's main PP processing and export markets in Limbe and Blantyre city, which are essential for sustainable PP development (Makoka, 2009; CISANET, 2015).

Power relations resulting from socioeconomic/class differentiation (based mainly on wealth status and formal authority) emerged as the uniting theme that shaped social relations of PP and livestock production and configuration of shared interests at particular sites, and the emergence (or not) of CBLM. Qualitative tools, including wealth analysis and ranking of cash crops and barriers to PP production, permitted assessment of the dynamics and outcomes of the ensuing power relations at particular sites. At Mpokwa, the relations revealed the relative local importance of PP growers through their wealth status relative to livestock owners manifested through their closely matched socioeconomic status, dominant leadership position of PP growers on the VACs, and the large proportion and influence of PP growers in the community.

Formal authority and the force of numbers also emerged as an important theme. Not only the presence but also the composition of institutions, the VAC for Mpokwa and farmer clubs for Bazale/Balaka, appeared to mediate CBLM emergence and performance, and constituted another dimension of power relations. In particular, the dominance of PP growers in VAC membership (all 10 members versus three who also raised livestock) at Mpokwa gave PP growers considerable influence over CBLM introduction and effective operation to meet their interests. The influence included the formulating of the most developed livestock-control rules extending PP protection throughout the year, and nested penalties graduated with increasing severity from the village to the group-village and Traditional Authority levels. These emerged as important elements of CBLM success, along with the economic incentives. However, having more than 70% of community members growing PP growing as a top non-maize cash crop showed that a vast majority had vested interests to promote PP and support CBLM arrangements, overcoming any participation 'social threshold' that may be needed for CBLM to emerge. In fact, Zomba and Balaka districts were among the top four PP producers in Malawi (Makoka, 2009).

Together, the socioeconomic status of PP growers and their dominance in VAC membership and the share of the community population helped to blunt the potential influence of livestock owners derived from their slightly higher wealth/class status. This is important because livestock owners were the potential losers in the new CBLM arrangements because they bore the burden of livestock 'containment' (herding, tethering, or stall-feeding) while PP growers enjoyed the benefits of PP protection from livestock damage. While the combined PP/livestock farmers may fit both sides, they reflected a win-win situation that tilted the balance in favor of PP growers and growing

In the three new/incipient sites (Gololomoti, Kandeu and Linthipe), the wide wealth-class differentials gave livestock owners more power to

**Table 5**
Qualitative factors associated with the emergence of community-based livestock management institutions.

| Site | Pigeon pea adoption threshold | Most important cash crop in order of importance | Community livestock management Institution | Socio-economic profile/ wealth status of pigeon pea growers | Possible triggers and motivations | Evidence of presence/absence of social capital | Initiator of community livestock management; Timeline |
|---|---|---|---|---|---|---|---|
| Linthipe | Sparsely grown by few farmers<br>(not an adoption area) | *Maize, groundnut, cowpea* | None | Cattle owners ranked as wealthiest farmers | None | Active church groupings, Village Dev't Committee (VDC)<br>Limited participation in community meetings | None initiated |
| Golomoti | Pigeon peas are recent<br>Minimal adoption | *Maize, groundnut, cotton* | None | Cattle owners and pigeon pea growers ranked equal in wealth | Relative power balance between PP growers and livestock owners | Active village savings and loans groups<br>Functioning cotton farmers groups<br>Limited trust among community members | None initiated |
| Kandeu | Pigeon peas are recent<br>Minimal adoption | *Maize, soya, groundnut* | None | Cattle owners ranked as the wealthiest farmers<br>Pigeon pea farmers are ranked as poor | None | Microcredit group exists for loan provision<br>Funstioning women's social welfare groups<br>Active tobacco clubs | None initiated |
| Mpokwa | Established pigeon pea area<br>Pigeon peas central to local economy<br>Approx. 70% of households grow pigeon peas<br>Demand for pigeon peas grew in 2007 | *Maize, pigeon peas, sweet potatoes* | Village Agricultural Committees (VACs)<br>Area Stakeholder Panel (ASP)<br>District Stakeholder Panel | *Pigeon pea growers ranked as wealthier than livestock owners* | High economic value and prices of pigeon peas<br>Approx. 70% of households grow PPs<br>Relatively reliable markets for pigeon peas<br>Chiefs more actively in pigeon pea promotion<br>Balanced power between PP growers and livestock owners | Greater trust and cohesion among community members<br>*Pigeon pea cooperatives to enhance bargaining power and prices*<br>Multiple agricultural groups (forest club, maize group, village bank etc)<br>Village Agricultural Committees (VACs) | VACs established in 2007<br>Pigeon pea clubs established<br>VACs and PP club formation facilitated by local extension officers |
| Balaka | Established pigeon pea area<br>100% of households grow pigeon peas<br>Hired labor for pigeon pea plots | *Cotton, tobacco, pigeon peas* | Livestock clubs | *Cattle owners and pigeon pea growers ranked equal in wealth* | Moderate economic value and prices of pigeon peas<br>Pigeon pea ranked with cash crops<br>Moderate market availability for pigeon peas<br>Balanced, moderate power between PP growers and livestock owners | Livestock clubs formed<br>Community members see each other as siblings,<br>Several village clubs exist for various development/social purposes<br>Village Development Committee is active | Livestock clubs established during Farm Income Diversification Program II, FIDP<br>Facilitated by extension officers |

resist or block the emergence of CBLM restrictions beyond the rainy season, or to obtain favors from traditional leaders in the resolution of cases of livestock-based crop damage. The latter was a common frustration among livestock owners in Golomoti and Kandeu. Kandeu was the best example of potential influences of such power differentials and ensuing severe livestock-damage barrier to PP production/adoption (Table 1), and of conflict between livestock owners and PP growers.

Community-based natural resources management (CBNRM) involves individuals incurring shared transaction costs to secure individual rights over valued common-pool natural resources (Adhikari and Lovett, 2006; Zulu, 2008). For Mpokwa (and to a lesser extent Bazale/Balaka), CBLM provided collective institutional arrangements over management of private property (pigeon peas and livestock). The arrangements mitigated individual transaction costs among growers of protecting PP, including time, labor, and money for protection strategies. Although powerful PP-growing individuals had stronger motivations and potential influence on the introduction of and support for CBLM arrangements, CBLM also advanced other broader community benefits. The deterrence role of CBLM helped livestock owners to avoid potential adjudication costs (compensation, fines, and time) (Table 5). Livestock confinement also reduced the risk of animal theft and road kill. CBLM-based protection extended to other crops during the dry season (e.g. cassava, vegetables, and tree seedlings), and prevented ridge damage from trampling. By attending community sensitization meetings, following agreed livestock-control or crop-protection rules, and assisting in monitoring, the broader Mpokwa community took ownership, and shared and reduced the individual burden of PP protection.

At the new sites (Kandeu and Golomoti), the shared sense of community responsibility over crop protection that underlies the chief-based system during the rainy season (to protect maize, 'life') was weakened during the dry season. Individual growers and livestock owners bore nearly all the burden of preventing livestock damage during the dry season. The shared preference for CBLM institutional arrangements for controlling livestock damage at all the five sites suggests a positive mediating role for community institutions.

This study contributes to the literature on sustainable agriculture intensification and PP scale-up beyond affirming previously identified barriers to PP production and scale-up (e.g., Snapp et al., 2002; Bezner Kerr et al., 2007; Franke et al., 2014; Mhango et al., 2013; African Center for Biodiverity, 2016; Rogé et al., 2016). First, livestock damage is a potential major barrier to PP adoption or scale-up. Second, variation in the configuration and relative importance of barriers at different sites and levels or duration of PP growing is a crucial consideration (Table 1). With rare exceptions (e.g., Snapp et al., 2002; Bezner Kerr, 2009; Me-Nsope and Larkins, 2016b), the literature has neglected livestock damage as a major barrier to PP scale- up in Malawi and other SSA countries. Findings suggest that scale-up efforts should consider livestock control more seriously in areas with relatively high livestock levels while PP production (e.g., poor seed availability, erratic rainfall, pests and diseases) and market factors are important to consolidate production in more established ones.

## 6. Study limitations

While providing useful insights on an understudied topic, this exploratory, qualitative study is based on a relatively small number of communities and key informants, and serves more to assess emerging issues, themes, and concepts, and generate—rather than test— hypotheses. The five sites selected had higher rates of livestock ownership than the national average, uniquely allowing initial examination of issues related to emergence of community and other livestock-control strategies. However, this may skew (overstate) the importance of livestock as a barrier to PP scale-up nationally. Further, other contextual factors, such as colonial and post-colonial government policies, and geographic variation in project/program support, may be stronger drivers of low PP take-up than community-level impacts. The limitations of our study point to some directions for future research. For example, testing the emergent hypothesis linking economic incentives to CBLM emergence, mediated by class-based power relations among major stakeholders (mainly livestock owners, PP growers, and village heads) and the stage/duration of PP growing, requires future empirical analysis, including household surveys and more in depth qualitative studies over a longer duration. For instance, the relative importance of community (including CBLM emergence, performance, and sustenance) and market (economic) factors relative to current and colonial government policies (e.g., narrow promotion of maize and tobacco as the main crops), quality of extension services, market opportunities, cooperatives, and geography as potential drivers of PP adoption and scale-up need further research. Further, while participatory wealth ranking and analysis based on FGDs provided valuable findings on social class differentiation and potential relative influence of pigeon pea growers compared to livestock owners, future work should disaggregate the different livestock (cattle, goats, chickens etc.), and properly characterize whether livestock ownership, numbers, and types are consistent with community perceptions on wealth and class.

## 7. Conclusion

Guided by an agrarian political economy lens, and using FGDs, PRA, and key-informant interviews in five communities in central and southern Malawi, this qualitative study showed that the configuration and relative importance of barriers to PP adoption and scaling up varied across sites and stages/duration of PP adoption. Communities in the new PP-growing sites (Golomoti and Kandeu sites) indicated that livestock damage was the biggest obstacle to PP growing. Factors of production (low yielding varieties, poor rain, and pests) were secondary. In contrast, production factors emerged as dominant barriers in the more established PP-growing sites (Mpokwa and Balaka), while livestock damage was largely controlled. Poor prices and markets were the next critical barriers in both the new and relatively established sites. Poor access to inputs, poor markets, and pests/diseases inhibited PP adoption at the low/non-growing site, Linthipe.

Chief-based livestock-control systems provided reasonable PP protection during the main growing season but were insufficient during the dry season after maize was harvested but PPs remained in the fields. CBLM emerged as the most preferred strategy to deal with livestock damage at all sites. CBLM institutional arrangement via the Village Action Committee at the Mpokwa site provided monitoring and community sensitization, and facilitated rule-formulation and conflict resolution. Enforcement of rules that extended livestock restrictions throughout the year were critical for CBLM effectiveness. They supplemented efforts of individual growers to protect pigeon peas, such as guarding, fencing, growing PP far from settlements, or applying animal faeces as livestock repellents. These individual efforts were costly in time, effort, money, and land, but were either rarely used or ineffective. CBLM arrangements allowed livestock owners to avoid potential adjudication costs in the form of fines and time.

Emerging issues, themes and ideas led to generation of the following hypothesis: smallholder farmers are likely to invest time and energy in collective livestock management to prevent damage to pigeon peas when expected economic benefits of adoption exceed perceived costs for most growers, but class-based power relations among major stakeholders, local institutions, and the duration of PP growing mediate the relationship. The most established PP-growing community, Mpokwa, had experienced relatively good PP prices with easier access to a reliable PP market (Blantyre city), and a shared local recognition of PP as a major cash crop grown by most community members. Relatively wealthy PP growers dominated livestock owners within the Village Agricultural Committee that led CBLM. CBLM emergence mitigated livestock damage effectively at Mpokwa.

If affirmed by further empirical analysis, initial findings suggest that

policies and strategies that develop and effectively connect smallholder farmers to reliable PP markets and competitive prices may also incentivize emergence of CBLM approaches to mitigate livestock damage, depending on the balance of power, thereby facilitating scaling up in new areas where livestock damage may be a major barrier. Improving production strategies, such as improved access to early maturing seed varieties and pesticides, and strengthened extension services can help to consolidate multiple PP-growing gains. They may also enhance incentives for effective livestock control/PP protection, such as CBLM and other appropriate institutional arrangements that extend effective protection of PPs from livestock damage into the dry season.

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